REMARKS

This Preliminary Amendment cancels, without prejudice, claims 1 to 12 in the underlying PCT Application No. PCT/EP2004/011535 and adds new claims 13 to 29. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and does not add any new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including the Abstract) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.

The underlying PCT Application No. PCT/EP2004/011535 includes an International Search Report, dated February 4, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

It is respectfully submitted that the subject matter of the present application is new, non-obvious and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

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OCCUPANT PROTECTION SYSTEM FOR A MOTOR VEHICLE

~~Description~~

FIELD OF THE INVENTION

The present invention relates to an occupant protection system for a motor vehicle. Such an occupant protection system may include an airbag and/or a belt tensioner.

BACKGROUND INFORMATION

Airbag systems are ~~disclosed~~ **described**, for example, in the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf.

U.S. **Patent No.** 5,583,771, U.S. **Patent No.** 5,684,701 and U.S. **Patent No.** 6,532,508 [[B1]] describe the triggering of an airbag by a neural network as a function of an output signal of an acceleration sensor.

[[DE]] **German Published Patent Application No.** 198 54 380 [[A1]] describes a method for detecting the severity of a vehicle collision, where the output signals of a plurality of acceleration sensors are supplied to a neural network. In the method, the start of the evaluation of the acceleration-sensor output signals is determined by a trigger signal, which is output by an acceleration sensor when it output signal exceeds a predefined threshold value. This acceleration sensor causes the other acceleration sensors to supply the specific output signal at one and the same time. It is also provided that the output signals of the acceleration sensors be integrated one or two times.

[[DE]] **German Published Patent Application No.** 100 35 505 [[A1]] describes a method, in which the future time

characteristic of the output signal of an acceleration sensor is predicted with the aid of a neural network on the basis of the acceleration-sensor signals at at least one defined time.

[[DE]] **German Published Patent Application No.** 100 40 111 [[A1]] describes a method for producing a triggering decision for restraining devices in a vehicle, where the difference of measured acceleration values is calculated and the magnitude of the difference is subsequently integrated. The integral is compared to at least one threshold value. If the integral does not exceed this threshold value by a predefined time, then the position of a triggering threshold for the measured acceleration or for a speed change derived from it is modified in such a manner, that the triggering sensitivity becomes lower.

Described in [[DE]] **German Published Patent Application No.** 101 03 661 [[C1]] is a method for sensing lateral impact in a motor vehicle; acceleration sensors, from whose output signals the difference is calculated, being situated on the left and right sides of the vehicle. The differential acceleration signal is integrated or summed up. For the purpose of side-impact sensing, the differential speed signal is compared to a threshold value, which is calculated as a function of the differential acceleration signal.

SUMMARY

~~The object~~ **Example embodiments** of the present invention ~~is to~~ **may** provide ~~an improved~~ occupant protection ~~system~~ **systems** for a motor vehicle, ~~in particular~~ **e.g.,** an occupant protection system including an airbag and/or a belt tensioner. In so doing, it ~~is particularly desirable~~ **may be provided** for the triggering of such an occupant protection system for a motor vehicle to be ~~especially~~ **particularly** precise.

~~The above-mentioned object is achieved by an~~ **An** occupant protection system for a motor vehicle ~~having~~ **may include** at least one crash sensor for measuring a motion variable of the motor vehicle, the occupant protection system including an occupant protection device controllable via an ignition signal, and a control unit for ascertaining or generating the ignition signal as a function of a time average, over at least a first time interval, of the motion variable measured by the crash sensor, and, ~~advantageously~~ **e.g.**, as a function of a time average of the motion variable measured by the crash sensor, over a second time interval different from the first time interval.

An occupant protection device within the ~~meaning of the present invention is, in particular,~~ **present context may include, e.g.,** an airbag and/or a belt tensioner.

An average value within ~~the meaning of the present invention~~ **present context** may be an arithmetic mean or a weighted average. In the case of such a weighted average, e.g., more recent values of the motion variable in the relevant time interval may be more heavily weighted than older values of the motion variable in the relevant time interval. An average value within the ~~meaning of the present invention~~ **present context** may also be a value proportional to an average value. ~~In an advantageous refinement of the present invention, the~~ **The** average value [[is]] **may be** a value proportional to the arithmetic mean. In this context, the average value ~~is advantageously~~ **may be** a value proportional to the integral of the motion variable in the relevant time interval or the sum of sampled values of the motion variable in the relevant time interval.

A motion variable of the motor vehicle within the ~~meaning of the present invention~~ **present context** may be an acceleration,

a speed, or a displacement, or a variable derived from one of these variables. In this context, the motion variable ~~is advantageously~~ **may be** an acceleration.

A crash sensor within the ~~meaning of the present invention~~ **present context** may be an acceleration sensor for measuring an acceleration in one or more directions. A crash sensor within the ~~meaning of the present invention~~ **present context** may also be a radar device, an infrared set-up, or a camera. In this case, a motion variable of the motor vehicle may be a distance of the motor vehicle from an obstacle, the first or second derivative of this distance, or another ~~equivalent~~ **similar** variable. A crash sensor within the ~~meaning of the present invention~~ **present context** may also be a sensor for measuring a deformation of the motor vehicle. Such a sensor may be a fiber-optic sensor or a sensor described in [[DE]] **German Published Patent Application No.** 100 16 142 [[A1]]. In this case, a motion variable of the motor vehicle may be a deformation of the motor vehicle, the first or second derivative of this deformation, or another ~~equivalent~~ **similar** variable.

An ignition signal within the ~~meaning of the present invention~~ **present context** may be a binary signal, which indicates if an occupant protection device, such as an airbag and/or a belt tensioner, should be triggered. Such an ignition signal within the ~~meaning of the present invention~~ **present context** may be a "FIRE/NO-FIRE" signal described in [[DE]] **German Published Patent Application No.** 100 35 505 [[A1]]. An ignition signal within the ~~meaning of the present invention~~ **present context** may also be a more complex signal, which indicates the degree (e.g., stage 1 or stage 2) to which an airbag should be fired. In addition, such an ignition signal within the ~~meaning of the present invention~~ **present context** may be a crash-severity parameter or an occupant acceleration

or loading described in [[DE]] **German Published Patent Application No.** 100 35 505 [[A1]]. An ignition signal within the ~~meaning of the present invention~~ **present context** may be, or include, an information item indicating the location and/or the direction of a collision.

~~Within the meaning of the present invention, a~~ **A** second time interval different from a first time interval may differ from the first time interval in its length and/or its position.

~~In a further advantageous refinement of the present invention, the~~ **The** ignition signal [[is]] **may be** ascertainable by the control unit as a function of time averages of the motion variable measured by the crash sensor in two to twenty, ~~advantageously~~ **e.g.,** in two to ten, different time intervals. ~~In a further advantageous refinement of the present invention, the~~ **The** ignition signal [[is]] **may be** ascertainable by the control unit as a function of time averages of the motion variable measured by the crash sensor in two to five different time intervals. Different time intervals within the ~~meaning of the present invention~~ **present context** may differ from each other in the length and/or in the position.

~~In a further advantageous refinement of the present invention, the~~ **The** time intervals ~~are~~ **may be** between 1 ms and 200 ms long, ~~in particular~~ **e.g.,** between 4 ms and 32 ms long, and ~~advantageously~~**, e.g.,** between 8 ms and 24 ms long. ~~In one refinement of the present invention, the~~ **The** time intervals ~~are essentially~~ **may be** the same length, or they **may** vary in length.

~~In a further advantageous refinement of the present invention, at~~ **At** least two, ~~in particular~~ **e.g.,** adjacent, time intervals ~~are~~ **may be** staggered by between 1 ms and 50 ms, ~~advantageously~~ **e.g.,** by between 2 ms and 16 ms. ~~In a further advantageous~~

~~refinement of the present invention, all~~ **All** adjacent time intervals ~~are~~ **may** each **be** offset from each other by between 1 ms and 50 ms, ~~advantageously~~ **e.g.,** by between 2 ms and 16 ms.

~~In a further advantageous refinement of the present invention, the~~ **The** occupant protection system ~~includes~~ **may include** at least one additional crash sensor for measuring a motion variable of the motor vehicle, the ignition signal also being ascertainable by the control unit as a function of at least one time average of the motion variable measured by the additional crash sensor over a time interval. ~~In a further advantageous refinement of the present invention, the~~ **The** additional crash sensor [[is]] **may be** positioned more than 0.5 m away from the crash sensor mentioned at the outset.

~~The above mentioned object is additionally achieved by~~ **In** a motor vehicle, ~~in particular~~ **e.g.,** a motor vehicle including an occupant protection system that has one or more of the above-mentioned features, the motor vehicle ~~including~~ **the motor vehicle may include** at least one crash sensor for measuring a motion vehicle of the motor vehicle and an occupant protection device controllable via an ignition signal, the motor vehicle including a control unit for ascertaining or generating the ignition signal as a function of a time average of the motion variable measured by the crash sensor over at least one first time interval, and ~~advantageously~~**, e.g.,** as a function of a second time interval of the motion variable measured by the crash sensor over a second time interval different from the first time interval.

~~The above mentioned object is additionally achieved by~~ **In** a method for operating an occupant protection system for a motor vehicle, ~~in particular~~ **e.g.,** by a method for operating an occupant protection system, having one or more of the above-mentioned features, the occupant protection system ~~including~~

includes an occupant protection device controllable via an ignition signal, and the ignition signal being ascertained as a function of a time average of a measured motion variable over at least one first time interval, and ~~advantageously~~**,** **e.g.,** as a function of a time average of the measured motion variable over a second time interval different from the first time interval.

A motor vehicle within the ~~meaning of the present invention is~~ **present context may include**, ~~in particular~~ **e.g.**, a land vehicle that may be used individually in road traffic. ~~In particular~~ **For example**, motor vehicles in the ~~sense of the present invention~~ **present context** are not restricted to land vehicles having an internal combustion engine.

Further ~~advantages~~ **features** and details ~~are derived from the following description~~ of exemplary embodiments~~, objects that are identical or substantially identical being denoted by the same reference numerals. The figures show:~~ **of the present invention are described in more detail below with reference to the appended Figures.**

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 **is** a plan view of a motor vehicle[[;]]**.**

Fig. 2 **illustrates** an exemplary embodiment of an occupant protection system[[;]]**.**

Fig. 3 **illustrates** an exemplary embodiment of a control module[[;]]**.**

Fig. 4 **illustrates** an exemplary embodiment of a triggering module[[;]]**.**

Fig. 5 **illustrates** an exemplary embodiment of an output signal of a crash sensor[[;]].

Fig. 6 **illustrates** the integral of the output signal [[of]] **illustrated in** Fig. 5, in one time interval[[;]].

Fig. 7 **illustrates** an exemplary embodiment of a neural network[[;]].

Fig. 8 **illustrates** an exemplary embodiment of a decision tree[[;]].

Fig. 9 **illustrates an** ~~a further~~ exemplary embodiment of a triggering module[[;]].

Fig. 10 **illustrates an** ~~a further~~ exemplary embodiment of a triggering module~~; and~~.

Fig. 11 **illustrates an** ~~a further~~ exemplary embodiment of a triggering module.

DETAILED DESCRIPTION

Fig. 1 ~~shows~~ **is** a plan view of a motor vehicle 1 having an occupant protection system, which is ~~represented~~ **illustrated** in Fig. 2 in the form of a block diagram. The occupant protection system includes at least an airbag 15, ~~which is not represented in Fig. 1 but in~~ **see, e.g.,** Fig. 2, and/or a belt tensioner 16, ~~which is not represented in Fig. 1 but in~~ **see, e.g.,** Fig. 2. The occupant protection system additionally includes a control unit 2 for triggering airbag 15 and/or belt tensioner 16, as well as a crash sensor S2 integrated into the right front end of motor vehicle 1 and a crash sensor S3 integrated into the left front end of motor vehicle 1. Crash sensors S2 and S3 are connected to control unit 2 by leads 5 and 6.

Crash sensors S2 and S3, as well as an additional crash sensor S1 integrated into control unit 2, as ~~shown~~ **illustrated** in Fig. 2, **may** take the form of acceleration sensors ~~in the present exemplary embodiment~~. Suitable acceleration sensors are described, for example, in chapter 3.2, 'Acceleration Sensor,' of the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf. Examples of suitable acceleration sensors include Bosch SMB060, Bosch PAS3 or Bosch UPF1. A suitable acceleration sensor may include, for example, a Bessel low-pass filter having a cutoff frequency of, e.g., 400 Hz. Crash sensors S1, S2, and S3 supply acceleration values aS1, aS2, and aS3, respectively, as output signals.

The occupant protection system additionally includes a belt sensor 11 for detecting if a seat belt is being used, and for outputting a corresponding belt information item MBELT. The occupant protection system further includes a seat-occupancy sensor 12 for detecting if, or how, a seat is occupied, and for outputting a corresponding seat-occupancy information item MSEAT. An example of a suitable seat-occupancy sensor is a pressure sensor integrated into the seat. Also suitable is an infrared scanning system described in chapter 3.3, "Interior Sensing," of the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf. Infrared scanning and fuzzy logic not only allow seat occupancy to be detected, but also allow a determination as to whether the seat occupant is an object, such as a purse, or a person. To this end, a line of, e.g., eight or more light-emitting diodes above the seat emit infrared light, and a CCD

matrix of 64 pixels records the scene illuminated in this manner. These charged coupled devices, abbreviated CCD, are made up of photodiodes and amplifier elements in matrix configurations. In this context, incident light releases charge carriers in each instance. A signal generated in this manner is amplified, processed, and stored. This procedure is repeated at different angles, and the seat is scanned in this manner. Image-processing algorithms and fuzzy-logic algorithms detect contours of objects and persons from these signals.

It may also be provided that the occupant-protection system include a control element 14 for activating or deactivating airbag 15. A corresponding switching signal is designated by reference character ONOFF.

Control unit 2 includes a control module 10 for calculating and outputting an ignition signal AIR fur airbag 15 and/or an ignition signal BELT for belt tensioner 16 as a function of acceleration values aS1, aS2, and aS3, belt information item MBELT, seat-occupancy information item MSEAT, and switching signal ONOFF.

Fig. 3 ~~shows~~ **illustrates** an exemplary embodiment of control module 10. Control module 10 includes a triggering module 20 for calculating and outputting an ignition recommendation CRASH as a function of acceleration values aS1, aS2, and aS3. Control module 10 additionally includes a firing table 21 for calculating and outputting ignition signal AIR for airbag 15 and/or ignition signal BELT for belt tensioner 16 as a function of ignition recommendation CRASH, belt information item MBELT, seat-occupancy information item MSEAT, and switching signal ONOFF. Thus, it may be provided that ignition signal AIR only be equal to ignition recommendation CRASH, when a corresponding seat is occupied by a person of a

specific size, and that ignition signal AIR otherwise be equal to 0.

Both ignition recommendation CRASH and ignition signals AIR and BELT may be ignition signals ~~within the meaning of the claims~~. Both ignition recommendation CRASH and ignition signals AIR and BELT may be a binary signal, e.g.**,** in accordance with the "FIRE/NO-FIRE" signal described in [[DE]] **German Published Patent Application No.** 100 35 505 [[A1]], which indicates whether an occupant protection device, such as an airbag and/or a belt tensioner, should be triggered. Both ignition recommendation CRASH and ignition signals AIR and BELT may also be a more complex signal. Both ignition recommendation CRASH and ignition signal AIR may be, for example, a more complex signal which indicates the degree (e.g.**,** stage 1 or stage 2) to which airbag 15 should be fired. Both ignition recommendation CRASH and ignition signal AIR may additionally include, for example, a crash-severity parameter described in [[DE]] **German Published Patent Application No.** 100 35 505 [[A1]] or an occupant acceleration or occupant loading. It may be provided that both ignition recommendation CRASH and ignition signals AIR and BELT ~~can~~ **may** indicate the location and/or the direction of a collision.

Fig. 4 ~~shows~~ **illustrates** an exemplary embodiment of triggering module 20. Triggering module 20 includes an analog-to-digital converter 25 (analog-to-digital converter) for sampling acceleration value aS1 and outputting a sampled acceleration value as1, an analog-to-digital converter 26 for sampling acceleration value aS2 and outputting a sampled acceleration value as2, and an analog-to-digital converter 27 for sampling acceleration value aS3 and outputting a sampled acceleration value as3.

The sampling frequency of the Δt of analog-to-digital converters 25, 26, and 27 may be, for example, 4 kHz. Triggering module 20 additionally includes (digital) integrators 31, 32, 33, 34, 35, and 36.

Using integrator 31, a pseudospeed value v0S1 at time t_0 is ascertained according to

$$v0S1 = \int_{t_0-\tau_0}^{t_0} as1 \cdot dt \ ,$$

where $\tau 0$ is the length of a time interval $[t_0-\tau_0, t_0]$ or 40 (cf., Fig. 5). Time t_0 designates the current time, i.e., the current value of time t.

Using integrator 32, a pseudospeed value v1S1 at a time $t_0-\tau_1$ is ascertained according to

$$v1S1 = \int_{t_0-\tau_0-\tau_1}^{t_0-\tau_1} as1 \cdot dt \ .$$

Using integrator 33, a pseudospeed value v2S1 at a time $t_0-\tau_2$ is ascertained according to

$$v2S1 = \int_{t_0-\tau_0-\tau_2}^{t_0-\tau_2} as1 \cdot dt \ .$$

Using integrator 34, a pseudospeed value v3S1 at a time $t_0-\tau_3$ is ascertained according to

$$v3S1 = \int_{t_0-\tau_0-\tau_3}^{t_0-\tau_3} as1 \cdot dt \ .$$

Using integrator 35, a pseudospeed value v0S2 at time t_0 is ascertained according to

$$v0S2 = \int_{t_0-\tau_0}^{t_0} as2 \cdot dt \ .$$

Using integrator 36, a pseudospeed value v0S3 at time t_0 is ascertained according to

$$v0S3 = \int_{t_0-\tau_0}^{t_0} as3 \cdot dt \ .$$

Fig. 5 and Fig. 6 illustrate the effect of integrators 31, 32, 33, 34, 35, and 36. In this context, Fig. 5 ~~shows~~ **illustrates** an example of the curve of (sampled) acceleration value as1 versus time t in the event of a frontal collision of motor vehicle 1 with an obstacle. Fig. 6 ~~shows~~ **illustrates** an example of a curve of pseudospeed value v0S1 for τ_0 = 24ms.

In the exemplary embodiment ~~shown~~ **illustrated** in Fig. 6, τ_1 is 17 ms, τ_2 is 34 ms, and τ_3 is 51 ms. ~~In one advantageous refinement,~~ τ_1 may be 8 ms, τ_2 may be 16 ms, and τ_3 may be 24 ms.

Pseudospeed values v0S1, v1S1, v2S1, v3S1, v0S2, and v0S3 are examples of time averages within the ~~meaning of the present invention~~ **present context**.

Triggering module 20 further includes a trigger generator 30 for generating trigger recommendation CRASH. Trigger generator 30 may take the form of a neural network, as ~~shown~~ **illustrated** in Fig. 7 in an exemplary embodiment.

The neural network ~~shown~~ **illustrated** in Fig. 7 includes six input nodes 50, 51, 52, 53, 54, 55, six covered nodes 60, 61, 62, 63, 64, 65, and an output node 70, each input node 50, 51, 52, 53, 54, 55 being connected to each covered node 60, 61, 62, 63, 64, 65, and each covered node 60, 61, 62, 63, 64, 65 being connected to output node 70. In Fig. 7, however, not all of the connections between input nodes 50, 51, 52, 53, 54,

55 and covered nodes 60, 61, 62, 63, 64, 65 are ~~shown~~ **illustrated** for reasons of clarity.

Pseudospeed value v0S1 is the input variable input into input node 50,
pseudospeed value v1S1 is the input variable input into input node 51,
pseudospeed value v2S1 is the input variable input into input node 52,
pseudospeed value v3S1 is the input variable input into input node 53,
pseudospeed value v0S2 is the input variable input into input node 54, and
pseudospeed value v0S3 is the input variable input into input node 55.
The output variable from output node 70 is ignition recommendation CRASH.

Details regarding neural networks may be found in U.S. **Patent No.** 5,583,771, U.S. **Patent No.** 5,684,701, and the documents "Techniques And Application Of Neural Networks", Taylor, M. and Lisboa, Ellis Horwood, West Sussex, England, 1993, "Naturally Intelligent Systems", Caudill, M. and Butler, G., MIT Press, Cambridge, 1990, and "Digital Neural Networks", Kung, S. Y., PTR Prentice Hall, Englewood Cliffs, NJ, 1993, cited in U.S. 5,684,701.

Table 1

```
/* Evaluation function */
int evaluate_Action(double *x)
{
     int CRASH;

     if (v0S3 < δ_v0S3 ) {
          if (v0S2 < δ_v0S2 ) {
               if (v2S1 < δ_v2S1 ) {
                    if (v0S1 < δ_v0S1 ) {
                         CRASH = 0;
                    } else {
                         if (v0S3 < δ_v0S3,2 ) {
                              CRASH = 0;
                         } else {
                              if (v0S1 < δ_v0S1,2 ) {
                                   if (v1S1 < δ_v1S1 ) {
                                        CRASH = 1;
                                   } else {
                                        CRASH = 0;
                                   }
                              } else {
                                   CRASH = 1;
                              }
                         }
                    }
               } else {
                    if (v0S2 < δ_v0S2,2 ) {
                         CRASH = 0;
                    } else {
                         if (v0S3 < δ_v0S3,3 ) {
                              CRASH = 0;
                         } else (
                              CRASH = 1;
                         }
                    }
               }
          } else {
               CRASH = 1;
          }
     } else {
          CRASH = 1;
     }
     return (CRASH);
}
```

As an alternative, trigger generator 30 may take the form of a sequence of comparisons to limiting values. Table 1 ~~shows~~ **illustrates** such a sequence of comparisons to limiting values,

the code ~~shown~~ **illustrated** in Table 1 having been automatically generated by a learning process. For the code ~~shown~~ **illustrated** in Table 1, τ_1 is 4 ms, τ_2 is 8 ms, and τ_0 is 24 ms.

Fig. 8 ~~shows~~ **illustrates** the code of Table 1 represented as a decision tree 80. In this context, reference numeral 81 denotes the inquiry as to whether v0S3 is less than a limiting value δ_{v0S3}.
Reference numeral 82 denotes the inquiry as to whether v0S2 is less than a limiting value δ_{v0S2}.
Reference numeral 83 denotes the inquiry as to whether v2S1 is less than a limiting value δ_{v2S1}.
Reference numeral 84 denotes the inquiry as to whether v0S1 is less than a limiting value δ_{v0S1}.
Reference numeral 85 denotes the inquiry as to whether v0S3 is less than a limiting value $\delta_{v0S3,2}$.
Reference numeral 86 denotes the inquiry as to whether v0S1 is less than a limiting value $\delta_{v0S1,2}$.
Reference numeral 87 denotes the inquiry as to whether v1S1 is less than a limiting value δ_{v1S1}.
Reference numeral 88 denotes the inquiry as to whether v0S2 is less than a limiting value $\delta_{v0S2,2}$.
Reference numeral 89 denotes the inquiry as to whether v0S3 is less than a limiting value $\delta_{v0S3,3}$.

~~According to~~ **As illustrated in** Fig. 8 and Table 1, trigger generator 30 disregards pseudospeed value v3S1. This is taken into account in the learning process, but is disregarded by the learning algorithm for generating the code according to Table 1.

Fig. 9 ~~shows~~ **illustrates** an exemplary embodiment of a triggering module 120 that is an alternative to triggering module 20. In this context, integrators 32, 33, and 34 are

replaced by lag elements 132, 133, and 134, which are positioned [[in]] such ~~a manner,~~ that pseudospeed value v1S1 results as pseudospeed value v0S1 delayed by time τ_1, pseudospeed value v2S1 results as pseudospeed value v0S1 delayed by time τ_2, and pseudospeed value v3S1 results as pseudospeed value v0S1 delayed by time τ_3.

One example of a possible (simple) implementation of integrator 31 (and appropriately adapted for integrators 32, 33, and 34) is

$$vS1(i) = c \cdot \Delta t \sum_{j=i-\frac{\tau_0}{\Delta t}}^{i} as1(j),$$

where i is a running index for specifying current time t_0 and is a constant. In this case, pseudospeed values v0S1, v1S1, v2S1, and v3S1 are yielded, for example, in accordance with the following relationships:

$$v0S1 = vS1(i)$$

$$v1S1 = vS1\left(i - \frac{\tau_1}{\Delta t}\right)$$

$$v2S1 = vS1\left(i - \frac{\tau_2}{\Delta t}\right)$$

$$v3S1 = vS1\left(i - \frac{\tau_3}{\Delta t}\right)$$

Fig. 10 ~~shows~~ **illustrates** an exemplary embodiment of a triggering module 220 that is an alternative to triggering module 20. In this context, integrators 32, 33, and 34 are replaced by integrators 232, 233, and 234. In this context, pseudospeed value v1S1 is ascertained via integrator 232 according to

$$v1S1 = \int_{t_0-\tau_1}^{t_0} as1 \cdot dt \ .$$

Using integrator 233, a pseudospeed value v2S1 at time t_0 is ascertained according to

$$v2S1 = \int_{t_0-\tau 2}^{t_0} as1 \cdot dt \ .$$

Using integrator 234, a pseudospeed value v3S1 at a time t_0 is ascertained according to

$$v3S1 = \int_{t_0-\tau 3}^{t_0} as1 \cdot dt \ .$$

In triggering module 20 ~~according to~~ **illustrated in** Fig. 4 and triggering module 120 ~~according to~~ **illustrated in** Fig. 9, the time intervals differ in their position. However, in triggering module 220 ~~according to~~ **illustrated** Fig. 10, the time intervals differ in their length. It may also be provided that time intervals differ in their length and in their position. A corresponding exemplary embodiment is ~~shown~~ **illustrated** in Fig. 11. Fig. 11 ~~shows~~ **illustrates** an exemplary embodiment of a triggering module 320 that is an alternative to triggering module 220. In this context, integrator 234 is replaced by an integrator 334, with the aid of which a pseudospeed value v3S1 at a time $t_0-\tau_4$ is ascertained according to

$$v3S1 = \int_{t_0-\tau_3-\tau_4}^{t_0-\tau_4} as1 \cdot dt \ .$$

~~In particular~~ **For example**, in connection with neural networks, automatically generated decision trees, or comparable, learning, evaluation procedures, ~~the present invention produces especially~~ **particularly** robust control of airbags and belt tensioners **may be provided**.

Although explained in the exemplary embodiments in view of airbags and belt tensioners for a frontal collision, the ~~present invention~~ **foregoing** should not~~, of course,~~ be **considered to be** restricted ~~to this case~~. ~~The~~ **Example embodiments of the** present invention [[is]] **are** also applicable to side airbags and other occupant protection systems. In one implementation for side airbags, crash sensors S2 and S3 may be ~~situated~~ **arranged**, for example, in the B-pillar. It may be provided that at least one pseudospeed value over at least one additional time interval be calculated for crash sensor S2 and/or crash sensor S3, as well.

A control unit within the ~~meaning of the present invention~~ **present context** may also be a distributed system. A control unit within the ~~meaning of the present invention~~ **present context** does not have to be accommodated in a single housing. A control unit within the ~~meaning of the present invention~~ **present context** may also be an individual chip or a printed circuit board.

To the extent that decision trees are mentioned in connection with the generation of ignition recommendation CRASH, these may also be replaced by regression trees, association tables, rule sets, supervector machines, or other machine-learning procedures**, etc**.

Instead of motion variables or their average values, differences of motion variables, average values of these differences, and/or differences of average values may also be used. Thus, e.g.**,** a subtractor may be provided in front of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334 **illustrated** in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, so that instead of sampled acceleration values as1, as2, as3,

differential values Δas1, Δas2, Δas3 are input variables of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334, Δas1 being equal to difference as1-as2, Δas2 being equal to difference as1-as3, and Δas3 being equal to difference as2-as3. In addition, it may be provided that differential value Δas1 be processed in the same manner as sampled acceleration value as1 **illustrated** in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, that differential value Δas2 be processed in the same manner as sampled acceleration value as1 **illustrated** in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, and/or that differential value Δas3 be processed in the same manner as sampled acceleration value as2 **illustrated** in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11. In this case, the number of integrators and the number of input variables are to be appropriately adapted to trigger generator 30.

Differences may also be time differences. Thus, it may be provided that differential values Δas1, Δas2, Δas3 be used in place of sampled acceleration values as1, as2, as3 as input variables of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334, Δas1(t) being equal to difference as1(t)-as1(t-τ), Δas2 being equal to difference as2(t)-as2(t-τ) or difference as2(t)-as3(t-τ), and Δas3 being equal to difference as3(t)-as3(t-τ) or difference as3(t)-as2(t-τ).

In accordance with above-mentioned variants with regard to the calculation of a difference, motion variables within the ~~meaning of the present invention~~ **present context** may also be differences of motion variables, when they are used as input variables.

One may proceed with pseudospeed values v0S1, v1S1, v2S1, v3S1, v0S2, v0S3 in an analogous manner. Accordingly, average values of motion variables within the ~~meaning of the present~~

~~invention~~ **present context** may also be differences of average values of motion variables or average values of differences of motion variables, when they are used as input variables.

~~List of Reference Numerals~~

LIST OF REFERENCE NUMERALS

1	motor vehicle
2	control device
5, 6	leads
10	control module
11	belt sensor
12	seat-occupancy sensor
14	control element
15	airbag
16	belt tensioner
20, 120, 220, 320	triggering module
21	firing table
25, 26, 27	analog-to-digital converter
30	trigger generator
31, 32, 33, 34, 35, 36, 232, 233, 234, 334	integrator
40	time interval
50, 51, 52, 53, 54, 55	input node
60, 61, 62, 63 64, 65	covered node
70	output node
80	decision tree
81, 82, 83, 84, 85, 86, 87, 88, 89	inquiry
132, 133, 134	lag element
AIR, BELT	ignition signal
aS1, aS2, aS3, as1, as2, as3	acceleration value
CRASH	ignition recommendation
ONOFF	switching signal
MBELT	belt information

MSEAT	seat-occupancy information
S1, S2, S3	crash sensor
t	time
t0	current time
v0S1, v1S1, v2S1, v3S1, v0S2, v0S3	pseudospeed value
$\tau_0, \tau_1, \tau_2, \tau_3$	length of a time interval

ABSTRACT

An occupant protection system for a motor vehicle includes at least one crash sensor for measuring a motion variable. The occupant protection system includes an occupant protection device, controlled by an ignition signal, and a control device for determining the ignition signal subject to an average time value of the motion variable measured by the crash sensor during at least one first time interval.